

Base of the Silurian in the Lake District and Howgill Fells, Northern England

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Synopsis

The basal Silurian in the Lake District and Howgill Fells is divided into four slightly different depositional zones, only one of which shows a provable base to the *acuminatus* Zone, being underlain by a *persculptus* fauna and overlain by an *atavus* fauna. Other sections have 'Basal Beds' which certainly represent very condensed deposition of carbonates, perhaps involving non-sequences. The varied environments are interpreted as part of an offshore fault-scarp-cum-ridge-and-hollow system paralleling the Iapetus Suture and situated upon the southern (northward-dipping) plate.

There are essentially four rather different depositional environments at the Ordovician–Silurian boundary in the Lake District proper and in the Howgill Fells; and these are each different again from the facies and faunal development at Cross Fell, dealt with by Wright elsewhere in this volume. The four types are shown in Figs 1–4: although drawn diagrammatically it is important to realize that there are no exposure gaps in the region of the boundary, and that the sections in the Howgill Fells and western Lake District (Figs 1, 4) can be confirmed in many other nearby sections.

The *acuminatus* Zone fauna, the new basal Silurian zone, is well represented except in one small region only, namely the classic Skelgill section (Fig. 3), the type section of the Skelgill Beds black shale formation. On this section there is a thin, hard, partly calcareous and partly siliceous shelly mudstone (usually referred to in the literature as the Basal Beds). A similar bed occurs in the Howgill Fells, but the age on Skelgill could range from the *persculptus* Zone to the lower *atavus* Zone inclusive, for it is underlain by Ashgill Shales (Hirnantian; and probably of *anceps* Zone age) and overlain by upper *atavus* Zone black shales. The Basal Beds certainly represent a period of condensed deposition and possibly of non-sequence. There is no direct evidence of hardground criteria. The shelly fossils include *Atrypa flexuosa* and may represent relatively deep water community life with low diversity.

In the Howgill Fells and the eastern Lake District (Figs 1, 2) the *acuminatus* Zone is well established but its base, and hence the base of the Silurian, cannot be proved: the Basal Beds in the Howgill Fells might be of *persculptus* Zone age, but a possible bentonite separates those beds from the thin *acuminatus* Zone black shale; and at Browgill a 0.08 m rottenstone, possibly the lithological and stratigraphical equivalent of the Basal Beds, separates Hirnantian Ashgill shales from black, *acuminatus* Zone shales.

Only in the western Lake District (Fig. 4) can the base of the Silurian be unequivocally placed, albeit on numerous sections in the region. The Yewdale Beck section is well and continuously exposed, and above 0.3 m of beds with a good *persculptus* Zone fauna are 11 m of black shales with a very rich assemblage of *acuminatus* Zone graptolites (Hutt 1974). The *persculptus* Zone also contains numerous shelly fossils of most groups, but they have not been extensively studied. The Ashgill Shales below them yield numerous brachiopods and rarer trilobites giving a Hirnantian age to the Ashgill Shales, but graptolites in these beds are rare. The *acuminatus* Zone black shales yield shelly fossils only very infrequently and none to date have proved to be of diagnostic value. In every other respect, however, the Yewdale Beck section provides a good confirmatory section for the base of the Silurian, especially as an almost infinite number of both natural and artificial sections are available in the general region of Coniston and on the fells and streams to the southwest of that town. Graptolites from these sections can be collected by the hundred and, as with all other *acuminatus* Zone faunas mentioned above, almost all the typical species of the zonal assemblage occur.

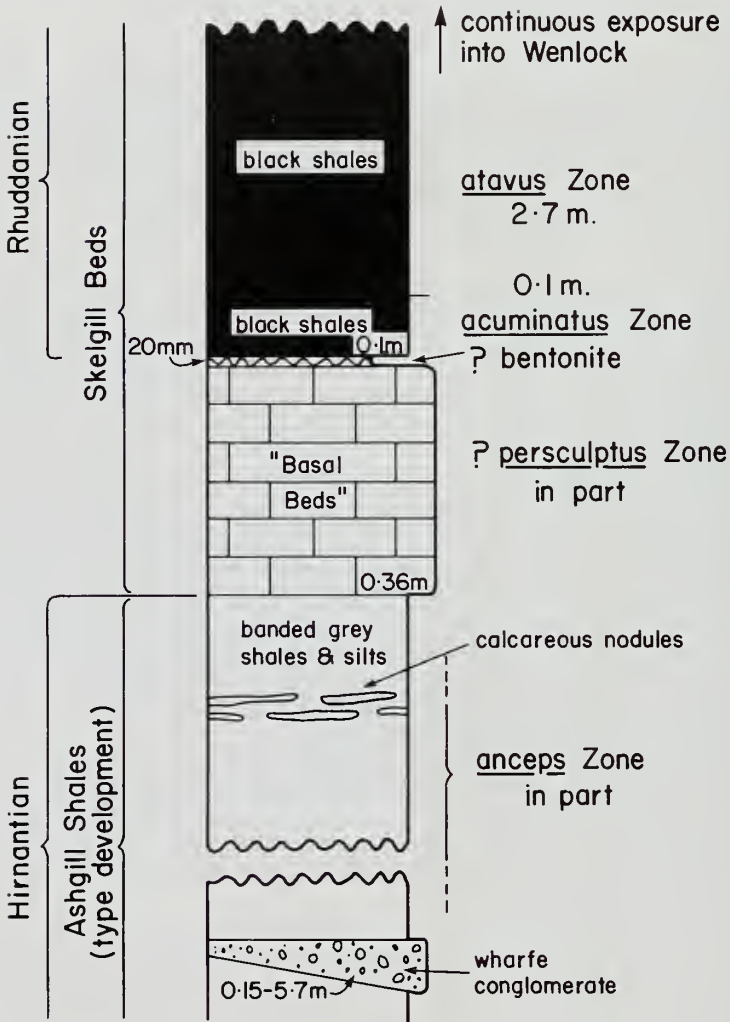


Fig. 1 Howgill Fells: beds about the Ordovician-Silurian boundary on Spengill, Grid Reference SD 698998.

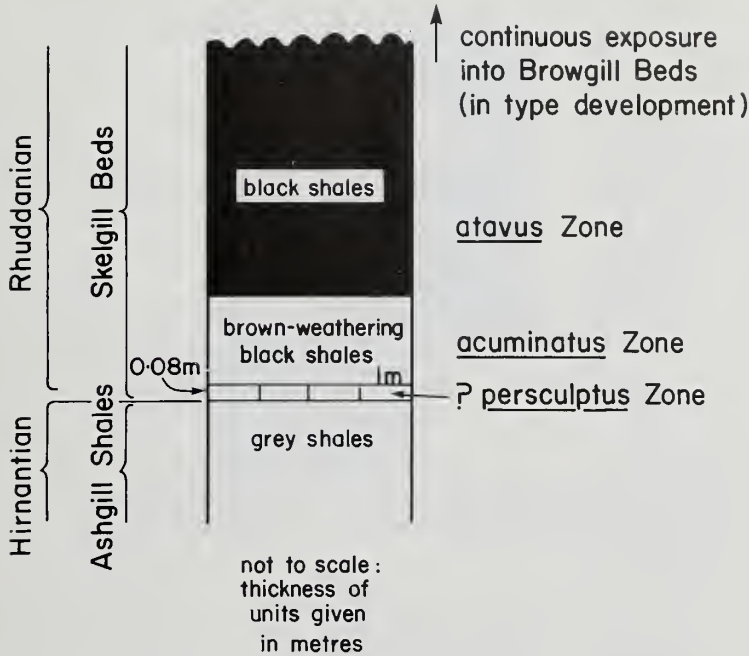


Fig. 2 Eastern Lake District: beds about the Ordovician-Silurian boundary on Browgill, NY 4974 0587.

Rickards (1978) attempted a general interpretation of the environment of deposition of the basal Silurian strata, envisaging a west- or northwest-facing fault scarp, according to Hutt (1974) active during deposition of the early Llandovery, against which were deposited deeper offshore, black shales and upon which and behind which were deposited the Basal Beds and their equivalents. By upper *atavus* Zone times the scarp feature was further submerged and covered in black shale deposition. Associated with these features were a series of ridges and hollows striking ENE/WSW, that is roughly the same as the fault scarp strike. The hollows received a greater thickness of black shale in a more highly anaerobic environment (Rickards 1964). The ridge and hollow system persisted in the Howgill Fells region, and possibly in the main Lake District outcrop, until late in the Llandovery.

Thus the onset of the Silurian in the Lake District is marked by condensed deposition of shelly limestone, and possible non-sequences, in the eastern, presumed shoreward or shallower region; and by relatively thick, black shale deposition in the western Lake District. The post-glacial marine transgression is recorded in the gradual spread of black shale deposition over the whole region, the last area to succumb being the eastern Lake District area of Skelgill which is interpreted as being on the crest of an old scarp structure, itself certainly operative as far back as the Caradoc. It seems likely that the region was situated atop the northward-dipping plate, south of the Iapetus Suture. The scarp and ridge/hollow systems may be a result of the northwards subduction process, to which they are parallel, and which resulted in a combination of compressional and extensional features.

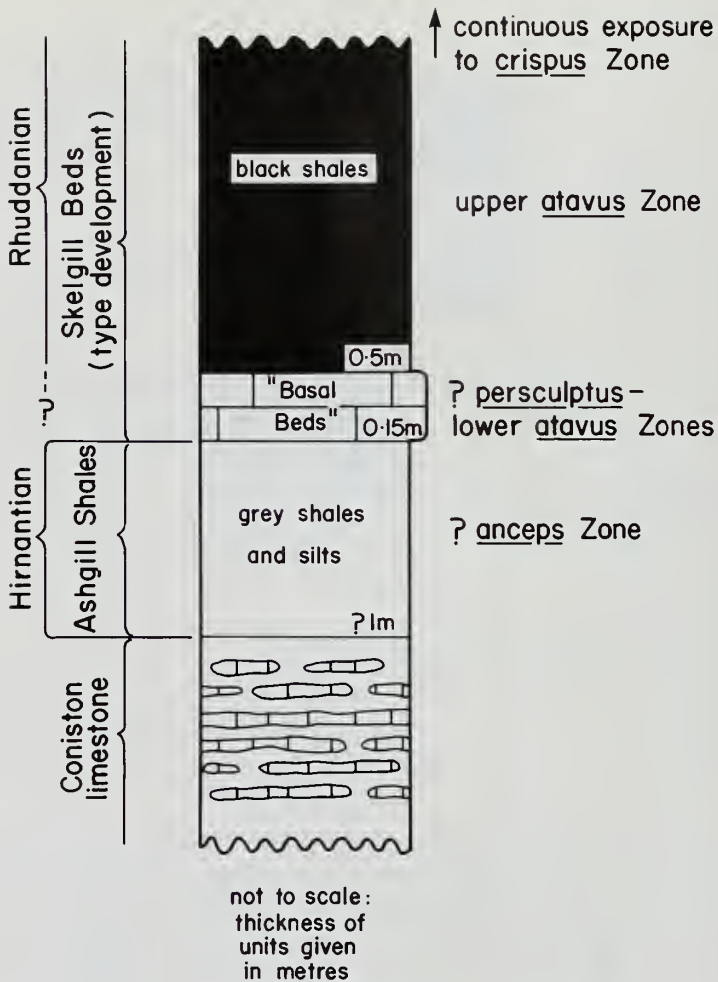


Fig. 3 Eastern Lake District: beds about the Ordovician-Silurian boundary on Skelgill, NY 3964 0320.

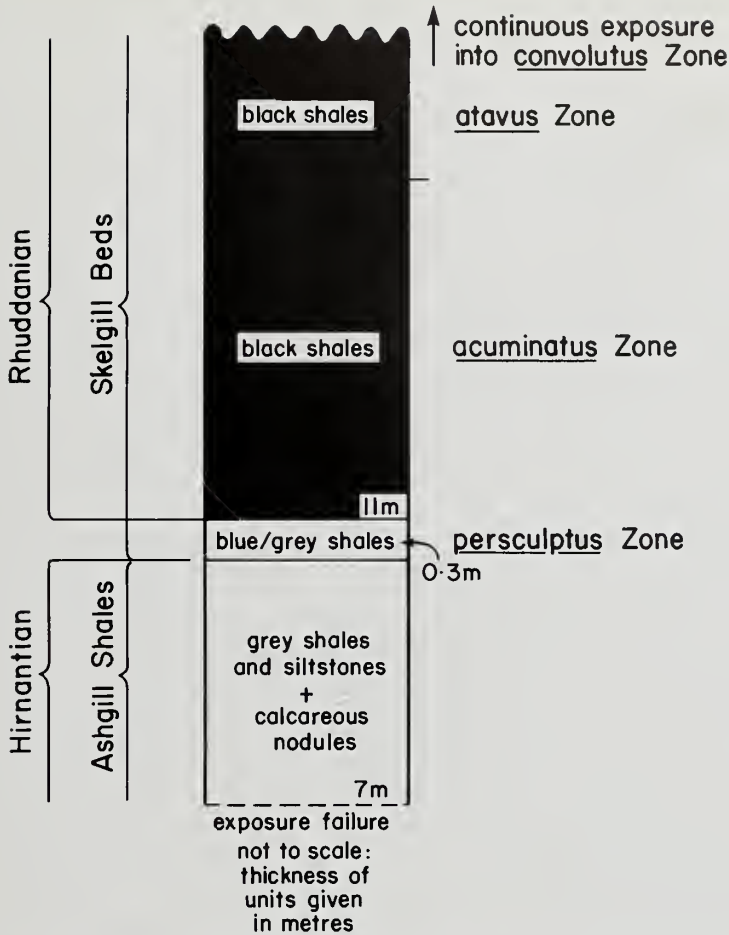


Fig. 4 Western Lake District: beds about the Ordovician-Silurian boundary at Yewdale Beck, SD 3073 9858.

References

- Hutt, J. E. 1974. The Llandovery graptolites of the English Lake District. Part 1. 56 pp., 10 pls. *Palaeontogr. Soc. (Monogr.)*, London.
- Rickards, R. B. 1964. The graptolitic mudstone and associated facies in the Silurian strata of the Howgill Fells. *Geol. Mag.*, Hertford, **101**: 435-451.
- 1978. In J. K. Ingham *et al.*, The Upper Ordovician and Silurian Rocks. In F. Moseley (ed.), The Geology of the Lake District. *Occ. publ. Yorks. geol. Soc.* **3**: 121-245.